

Nauphæus miliaris. Pl. XVI. fig. 3.

N. oblongo-obovatus, niger, supra granulis nitidis nigro circumdatis confertim maculatus, interstitiis griseo-squamosis, medio prothoracis elytrorumque antice linea grisea notatis; capite supra oculos dense squamoso, maculis duabus fuscis decorato; rostro prothorace multo brevior, testaceo, subtiliter remote punctulato, basi squamoso; antennis testaceis; prothorace pone apicem utrinque macula obliqua nigra; scutello distincto, orbiculari; clytris lateribus modice rotundatis, basi pone scutellum paulo gibbosis, in medio dorsi utrinque perparum longitudinaliter excavatis, striato-punctatis, interstitiis latis, vix convexis, confertim uniseriatim granulatis, medio macula rotundata nigra ad suturam approximata, plagisque duabus oblongis margine externo, ornatis; corpore infra femoribusque densissimo eburneo-squamosis; tibiis tarsisque squamis filiformibus minus dense vestitis, his infra flavo-tomentosis. Long. $4\frac{1}{2}$ lin.

Hab. Waigiou, Mysol.

[To be continued.]

XXV.—*Ceratodus, and its Place in the System.*

By Dr. ALBERT GÜNTHER, F.R.S.

THE general external appearance of this most remarkable fish has been described by Mr. Krefft in Proc. Zool. Soc. 1870, p. 221. My observations* are based on three specimens, viz. one without intestines, one fully developed male, and one female which does not appear to have attained to maturity. Differences in the number and microscopical structure of the scales seem to indicate the existence of a second species beside that described by Mr. Krefft as *Ceratodus Forsteri*. Its scales are considerably smaller and more numerous; and it may be named *Ceratodus miolepis*.

The skeleton represents the type which is so well known from Owen's, Bischoff's, and Hyrtl's descriptions of *Lepidosiren* and *Protopterus*. In certain points of detail, such as the arrangement of the bones of the skull, the form of the cerebral and acoustic cavities, the development of the first rib and apophyses generally, the structure of the scapular arch and pelvis, the resemblance of the genera named is perfect; and from an examination of the skeleton alone the conclusion might have been drawn that they belong to the same natural

* The following notes are a short *résumé* of a memoir presented to the Royal Society at the beginning of last month, and containing a detailed description of the entire organization of *Ceratodus*, with the exception of the nervous system.

group of fishes. The skeleton is notochordal, all its parts having a cartilaginous basis, more or less incompletely covered by thin osseous lamellæ. Some of the thickest bones of the skull have a spongy texture, and there is also a cavity of considerable size in the pelvis; but otherwise the skeleton is composed of solid cartilage (that is, the primordial base of bone); and therefore it is scarcely correct to describe the skeleton of *Ceratodus* or of *Cœlacanth*s as composed of bones "hollow like those of birds."

The ossifications of the skull may be designated thus:—

1. Ethmoid.
2. A pair of frontals separated by a "scleroparietal," which is membranaceous in *Lepidosiren*.
3. Basal. The vomer is cartilaginous and tooth-bearing, as in *Lepidosiren* and *Protopterus*, in which it has been described as intermaxillary.
4. A pterygo-palatine on each side of the basal—tooth-bearing, and sutureally united with its fellow.
5. An os quadratum, represented by an osseous lamella coating the cartilaginous tympanic pedicle, which is provided with a double condyle.
6. Mandible with an articular and dentary lamella.
7. A well-developed rhomboid operculum and styliform suboperculum.
8. Hyoid arch, more complex than in *Lepidosiren*, consisting of a pair of cerato-hyals, a basi- and glosso-hyal.

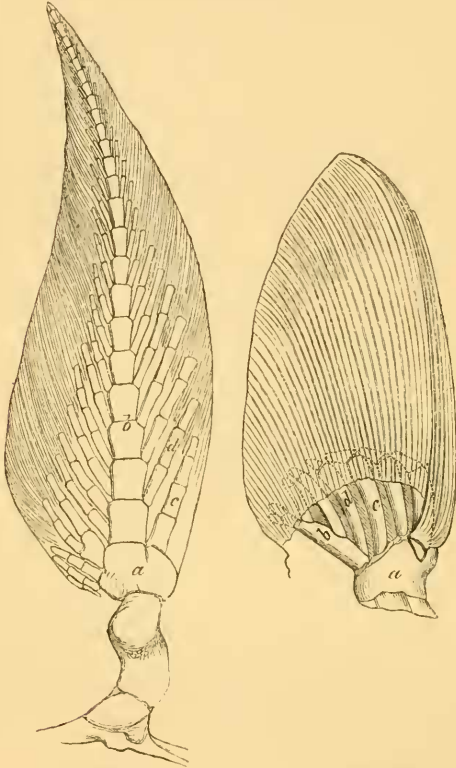
There are about 68 sets of apophyses, 27 of which bear ribs. The apophyses are most differentiated about the middle of the vertebral column; and towards the end of the trunk the neural portion consists of the following pieces:—

1. Cartilaginous arch of neurapophysis for the formation of the medullary canal.
2. Semiossified gable-like portion of the neurapophysis over the ligamentum longitudinale.
3. Neural spine.
4. Lower interneural.
5. Upper interneural, to which the dermo-neurals are attached in the same manner as in *Protopterus*.

The hæmal portion is of very similar construction.

The fore and hind paddles are supported by a cartilaginous axial skeleton—that is, by a median longitudinal series of joints with lateral divergent articulated branches, each joint forming the base for a right and left branch. I have no doubt that the Ganoids of the Devonian epoch with "acutely lobate" fins had the paddles supported by a similar internal skeleton. In *Lepidosiren* and *Protopterus* only the jointed axis is per-

sistent, the lateral branches being either entirely absent (as in the former), or quite rudimentary (as in the latter). In all these cases the analogy of this structure to the diphyocercy of the terminal portion of the tail is apparent, whilst a heterocercal condition is represented in the pectoral fin of *Acipenser*. In this fish the axis (*b*) is not inserted in the longitudinal median

*Ceratodus*.*Acipenser*.

a, carpal cartilage; *b*, jointed axis; *c*, branches having the carpus as base; *d*, branches having the axis as base.

line of the carpus (*a*), but quite at the inner corner; consequently branches exist on one side of the axis only, viz. on that side on which they are needed for the support of the fin-rays. The axis is comparatively short and feeble, composed of three joints, and forming the base for three branches (*d*). Three other branches (*c*) are inserted immediately into the

carpus: each branch consists of two joints. The fin-rays are attached to the cartilaginous branches exactly in the same way as all the fin-rays of *Ceratodus* or *Protopterus*. I may also observe that the "pectoral spine" of the sturgeon does not differ, either in structure or with regard to its attachment, from the other fin-rays; it is formed merely by confluent fin-rays, and can easily be split into two halves.

Eye without falciform process or choroid gland.

Ceratodus possesses a Dipnoous heart, as far as the ventricle and (single) atrium are concerned; but the valvular arrangement of the bulbus arteriosus is more of the "Ganoid" type. There is, at a short distance from the origin of the bulbus, a single cartilaginous papillary valve worked by a special muscle; then follows a transverse series of four small short valves (sometimes reduced to simple papillary prominences), then a series of four oblong raised strips (rudimentary valves?), and, finally, a third transverse series of four well-developed "Ganoid" valves. Four arcus aortæ enter the four gills without sending off branches; and four branchial veins are collected into the aorta descendens.

The branchial apparatus is composed of five arches, not differing from the Teleosteous type, but cartilaginous; four of them bear well-developed lamellated gills. The pseudo-branchia does not receive blood which has not previously passed through the gills. Spiracles are absent.

The lung is single, but its cavity is composed of two symmetrical halves, each with a row of about thirty cellular compartments. Pneumatic duct and situation of the glottis as in *Lepidosiren*. The pulmonary artery is a branch of the arteria cœliaca, and the pulmonary vein enters the atrium separately from the sinus venosus.

Like *Lepidosiren*, *Ceratodus* is provided with one pair of vomerine teeth, and two pairs of molar-like palatine teeth. This dentition is modified for a carnivorous diet in the former genus, and for an herbivorous one in the latter, the intestine of all specimens having been found full of leaves of Myrtaceæ and Gramineæ. The microscopical structure of the teeth resembles much that of *Protopterus*, *Psammodus*, *Dipterus*, and other extinct genera, and is identical with that of the fossil *Ceratodus*-teeth from Triassic and Jurassic formations, confirming the correctness of Mr. Krefft's view, who referred the living fish to the genus which had been established for those fossils.

Intestinal tract perfectly straight, very wide, with a perfect spiral valve, along the axis of which large glands are imbedded; stomach merely indicated by a shallow double pyloric fold; no pyloric appendages; spleen represented by a diffuse

glandular mass. Not only the liver, but also the paired lobed kidneys are provided with a portal system. The two ureters enter by a single opening into a small urinal cloaca, situated at, and partly confluent with, the dorsal wall of the rectum. Vent in the median line of the abdomen; a pair of wide peritoneal slits behind the vent. Testicle without developed vas deferens, but with a duct running along its interior, blind at both ends and without apparent outlet, but receiving the semen from the canaliculi seminiferi. Ovaries transversely laminate; the ova fall into the abdominal cavity, and are expelled by the peritoneal slits. A pair of narrow convoluted oviducts are present, each being confluent with the ureter of its side. It would appear, from the situation of the peritoneal openings of the oviducts in the foremost part of the abdominal cavity, and from the fact of one having been found closed, that these ducts have no function. However, it must be remembered that the female fish examined did not appear to have attained to maturity.

The evidence in favour of the close relationship between *Ceratodus* and *Lepidosiren* is so strong, that the difference in the arrangement of the valves of the bulbus arteriosus can no longer be considered to be of sufficient importance to distinguish the Dipnoi as a subclass from the Ganoidei. The Dipnoi form a suborder of Ganoid fishes which may be characterized thus:—*Ganoid fishes with the nostrils within the mouth, with paddles supported by an axial skeleton, with lungs and gills and notochordal skeleton, and without branchiostegals.* The Ganoids have hitherto been placed between the subclasses Teleostei and Chondropterygii; but they are evidently much more nearly allied to the latter than to the former, which, moreover, were developed in much more recent epochs. Therefore I propose to unite the Ganoids and the Chondropterygians into one subclass, PALÆICHTHYES, characterized thus:—*Heart with a contractile bulbus arteriosus; intestine with a spiral valve; optic nerves non-decussating.*

By a comparative study of extinct fishes, I have arrived at some conclusions the substance of which may be shortly indicated thus:—

1. The suborder Dipnoi was represented in the Devonian and Carboniferous epochs by the genus *Dipterus* (= *Ctenodus*), in which I have also found the internal nostrils and a pair of vomerine teeth; however, this genus is the type of a separate family, on account of its heterocercy.

2. The evidence with regard to *Phaneropleuron* (Huxl.) is less conclusive; and *Tristichopterus* (Egert.), with the complete segmentation of its vertebral column, should be excluded from this suborder.

3. The suborder Crossopterygii of Huxley contains two distinct types of "lobate fin," namely:—the "obtusely lobate," with a transverse series of cartilaginous rods; and the "acutely lobate" with an axial skeleton. Prof. Huxley has already drawn attention to the similarity between the paddles of *Lepidosiren* and the Crossopterygians; but only the acutely "lobate" type agrees with the structure of the Dipnoous limb. *Polypiterus*, *Cœlacanthus*, &c., which are provided with fins of the former type, are genera sufficiently distinguished also by other characters to be placed in a separate suborder.

XXVI.—On a new Genus and Species of Hydroid Zoophyte
(*Cladocoryne floccosa*). By W. D. ROTCH, Esq.

CLADOCORYNE, nov. gen.

Generic character.—Stem simple or branched, rooted by a creeping filiform stolon, the whole sheathed in a thin chitinous tube, smooth or very sparingly annulated. Polypites terminal, clavate, with simple and branched capitate tentacula; the former set in a single row round the mouth, the latter in several whorls round the body, and multicapitate; with a prominent tubercle composed of thread-cells between each tentacle in the anterior and in the posterior rows. Reproduction unknown.

Cladocoryne has affinity with the families of Corynidae and Stauridiidae, but is, I think, more closely allied to the former. It agrees with the Stauridiidae in having tentacles of two kinds, and resembles *Cladonema radiatum*, which has the tentacles of the gonozooid branched. The stem, general form, and polypite of *Cladocoryne* very closely resemble those of *Coryne* and *Syncoryne*, the branching of some of the tentacles in *Cladocoryne* being the most marked point of difference. The tubercles or bosses round the mouth and base of the polypite mark a point of resemblance between *Cladocoryne* and *Hydranthea*.

The reproductive history of *Cladocoryne* is unknown; and it is consequently uncertain whether it most resembles *Coryne* or *Syncoryne*.

Its present place must be provisional; and, until more is known of its reproduction, it might be placed in the family Corynidae, after the genus *Zunclia*, in the Rev. T. Hincks's work on British Hydroid Zoophytes.